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Distribution ecology – any way forward?

Distribution Ecology: From Individual Habitat Use to Species Biogeographical Range. Marcelo H. Cassini, 2013, Springer. 219 pp. £135 (Hardback) ISBN: 9781461464143; <http://www.springer.com>

Distributions are the basic stuff of biogeography—species' distributions mostly, but also the distributions of species' assemblages, populations, individuals and genes. An improved perspective on the drivers of distributions at these different organisational levels would help biogeographers investigate the mechanisms underlying whatever types of distributions they study. Such a perspective would also help those researching distribution processes at organisational levels far below the species level, e.g. behaviour or population dynamics, to identify the broader implications of their work.

The premise of this book is to help scientists frame their research at any one organisational level in the context of the processes that occur at other levels. To achieve this goal, the book covers both processes underlying distributions at different scales and common techniques for studying these processes. The book is structured hierarchically, first dealing with individuals, then moving through genes, aggregations, societies, subpopulations, populations, species, and species assemblages. Two chapters attempt to demonstrate the applied importance of distribution biology, one on conservation biology and one on animal production. The animal production chapter reads as somewhat out of date, and I wonder how many readers it will be relevant to, but the conservation biology chapter is certainly pertinent. The book ends with the author's perspective on how research could be integrated between organisational levels, and future directions for distribution ecology.

The book is intended to be an introductory overview, primarily aimed at graduate

students. Its scope means that there is much ground to cover, especially since it covers modelling approaches as well as concepts. Unfortunately I found the outcome unsatisfying. For example, an explanation of species distribution models, including their conceptual foundation, issues with extrapolation, different modelling techniques, variable selection, model fitting, and controversy regarding their accuracy, are all crammed into three pages. So much information is touched on that someone approaching the subject for the first time would struggle to comprehend the concepts introduced. In fairness, the book makes no pretence to be a one-stop shop to explain all of distribution ecology. It is made clear that anyone wishing to do research at a single organisational level would need a specialist text, and the reader is pointed in the right direction with extensive reference lists. Nevertheless, clarity would have been improved by identifying the most fundamental principles to be explained in each chapter, rather than touching too lightly on many topics.

The added value to be gained from the book's broad approach is a new perspective on integrating distribution ecology across multiple organisational levels. This could have been capitalised upon to a greater degree. The linkages between processes at different levels, and how they can be included in models, are rarely made explicit. This was a major disappointment of the book for me, as there are several great examples in the literature—species' distributions have been predicted using metapopulation models (Anderson et al. 2009) and with the behaviour of individuals (Kearney et al. 2009), and options for cross-

scale integration have been proposed (e.g. Guisan and Rahbek 2011).

One of the key features of this book is the provision of a “compendium of modelling products” (p. vii), drawing heavily from the primary literature to illustrate how models can be used to infer processes, and the uses to which the results can be put. This focus on the state-of-the-art in each subfield aids understanding of both process and model, although the examples could have been used to greater effect. They would have benefitted from greater discussion of the shortcomings of the techniques, best practice, knowledge gaps and the broad implications of the exemplar studies for distribution ecology—particularly at different organisational levels.

The book’s last chapter aims to synthesise the concepts and approaches used across the organisational levels covered, and I had hoped that it would go some way towards uniting the array of concepts covered. The author lays out two views of how distribution ecology can progress. First, we might conceptualise different organisational levels as being linked by hierarchy theory. Given that it is not explicitly defined how hierarchy theory applies to distribution ecology, I assume the main point to be that distributions at a given organisational level are limited by what goes on at the organisational levels above and below. This seems a reasonable way forward but the chapter didn’t go any further than the rest of the book in addressing cross-level integration. The second, ‘reductionist’, option was to consider that the individual is the basic unit of measurement, and the individual is what is ultimately being modelled when we study any kind of distribution. This conceptualization relies on the principle of the ‘generalised matching law’, i.e. that use of a site increases monotonically with the site’s quality. The term stems from animal psychology, and

when applied to sub-populations, populations, or species the generalised matching law broadly corresponds to niche theory. It is suggested that we can identify the drivers of actual distributions by looking for deviations from this pattern. I find this problematic. By relying on this as a null hypothesis we assume that site quality is the major factor driving distributions, and that the signal is so detectable that we can observe deviations from it. The former assumption is often incorrect, and, when it is correct, site ‘quality’ can be dependent on such a wealth of factors that it is extremely difficult to measure in the real world; at the species level we certainly haven’t figured out how to do it reliably. In any case, I would need more information than the two pages devoted to the topic to be convinced how the reductionist approach could be usefully applied. This chapter left me feeling unenlightened about what new research avenues could be opened by studying distributions on multiple organisational levels.

Finally, one of the key difficulties for users of this book is simply the poor quality of the writing and figures. As an interdisciplinary book the sheer quantity of technical terms was always going to be challenging, and a glossary is sorely missed. But even allowing for this, the text is littered with undefined terms and is inconsistently referenced. Many figures are challenging to interpret because of poorly descriptive legends and labels, and because no use is made of lettering to identify panels or graphs that are being discussed in the legend. Often the text is simply inconsistent. One example is a paragraph discussing a model of interspecific competition and resource use, which discusses population M in environment P, and population N in environment G. The meanings of P and G were switched halfway through. At some point ‘B’ turned up inexplicably, and suddenly some-

thing started eating N. Through the use of 'B' in a later graph and 'P' in the legend, it seems that B is actually P, but I never figured out who ate N. My criticism of the quality of the text is not nit-picky. The reader must frequently back-track to pick up the thread of the argument, or use a process of elimination to understand what parameter or process is being referred to. This makes reading the book a struggle, and presumably part of the responsibility lies with the publisher.

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